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QUALITY ASSURANCE FOR IAEA INSPECTION PLANNING

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ABSTRACT

Under the provisions of the Treaty on Nonproliferation of Nuclear Weapons and other agreements with states, the International Atomic Energy Agency (IAEA) conducts inspections at nuclear facilities to confirm that their operation is consistent with the peaceful use of nuclear material. The Department of Safeguards at the IAEA is considering a quality assurance program for activities related to the planning of these facility inspections. In this report, we summarize recent work in writing standards for planning inspections at the types of facilities inspected by the IAEA. The standards specify the sequence of steps in planning inspections, which are (1) administrative functions, such as arrangements for visas and travel, and communications with the state to confirm facility operating schedules and the state's acceptance of the assigned inspectors; (2) technical functions including a specification of the required inspection activities, determination of personnel and equipment resources, and a schedule for implementing the inspection activities at the facility; and (3) management functions, such as pre- and post-inspection briefings where the planned and implemented inspection activities are reviewed.

I. INTRODUCTION

Each year the International Atomic Energy Agency (IAEA) conducts over 2000 inspections at 400 facilities to verify the compliance of a state with agreements limiting the uses of nuclear material and facilities to peaceful purposes. The scheduling and completion of these inspections is a complex process that is carried out by the operations divisions of the IAEA. A key element in this process is planning by inspectors at IAEA headquarters before each inspection.

To ensure the continued effectiveness of this planning process, the Department of Safeguards is considering a quality assurance program for inspection planning. In this paper, we summarize some contributions to the quality assurance program including the development of a standard for planning and of criteria for monitoring planning quality.

II. FRAMEWORK FOR INSPECTION PLANNING

Inspection planning for IAEA safeguards is based on a theoretical framework called the safeguards approach. This approach is developed from an analysis of the credible scenarios for material diversion, the anomalies created by the diversion and concealment actions that constitute the scenarios, and the inspection activities that can detect the anomalies. For each facility type (such as light-water reactors, fuel fabrication plants, or reprocessing plants), recommended inspection activities are summarized in Routine Inspection Activities Lists (for example, see Ref. 1).

The safeguards approaches and activities lists are complemented by the Safeguards Implementation Report (SIR) criteria, which specify for each facility type and for various material categories the inspection activities constituting acceptable safeguards. There is close agreement between the inspection activities implied by the SIR criteria and those in the Routine Inspection Activities Lists.

The General Agreement between the IAEA and State under the Nuclear Nonproliferation Treaty provides for Subsidiary Agreements with the State that specify in detail how the procedures laid down in the Agreement are to be applied. In addition, for each facility the IAEA and State negotiate a facility attachment that describes the permitted inspection activities by the Agency, the State's obligations for reporting accounting information, and the facility operator's obligations for providing information and cooperation during an inspection. In negotiating the facility attachment, the safeguards approach for that facility provides the basis for the Agency's proposed inspection activities.

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III. INSPECTION ACTIVITIES

The function of inspection planning is to coordinate personnel and equipment resources to attain IAEA goals for verifying the peaceful use of nuclear materials and facilities. This verification is based on information gathered by the following three general areas of inspection activities.

- Audit of Records and Reports. Inspectors examine facility operating records, facility accounting records, and reports submitted by the state to confirm their completeness, correctness, and consistency. Typical activities are checking arithmetic correctness of accounting ledgers and confirming that operating and accounting records agree.

- Verification of Inventory. Inspectors verify that declared material inventories and inventory changes are correct by direct measurement of these quantities. Activities for material verification are development of sampling plans, sampling of material for destructive chemical analysis, and in-situ measurement of material by nondestructive methods.

- Containment/Surveillance. Seals, film cameras, closed-circuit television (CCTV), and seals are applied to provide continuous knowledge that material inventories are unchanged, to monitor for undeclared material movements, and to confirm the integrity of containments. Activities for containment/surveillance are planning location, field of view, and time setting of surveillance devices; servicing film cameras; and detaching and confirming the identity and integrity of seals.

IV. QUALITY ASSURANCE

Quality assurance consists of procedures for assuring that a process conforms to a specified level of performance. A quality assurance program includes a standard of excellence for the process, monitoring the realized process to detect deviations from the standard, and taking corrective actions. In this report some general methods are given for applying quality assurance procedures to the inspection planning process.

The proposed quality assurance program for inspection planning consists of (1) specifying the administrative and technical details of inspection planning, (2) documenting these planning procedures in a standard, (3) identifying quality characteristics that are essential attributes of inspection planning, (4) monitoring these characteristics to assure conformance to the standard, and (5) taking action to correct deficiencies.

Many elements of this quality assurance program are currently in place within the Agency. For example, the Operations Divisions perform briefings and debriefings for each inspection to monitor planning, and the Computerized Inspection Report documents the details of inspection planning and implementation. This paper characterizes these existing quality assurance functions and describes their incorporation into an overall quality assurance program for planning.

V. STANDARD FOR PLANNING

A standard for planning specifies the sequence of steps in the planning process to be performed at IAEA headquarters. The standard does not prescribe every detail of planning inspection activities; instead, only general planning areas (administrative planning, technical planning, and management review) are addressed with references to appropriate IAEA documents for the specifics of planning.

A. Administrative Planning

Administrative aspects of planning coordinate pre-inspection activities within headquarters and organize communications between the IAEA and the facility to be inspected and the relevant state. The internal administrative functions include arrangements for visas, travel, and accommodations and for inspection equipment, such as nondestructive assay instruments, surveillance cameras, and seals. Communications with the state are letters or telexes to confirm the scheduled visit, the facility operating schedule, and a state's acceptance of the inspectors.

B. Technical Planning

1. Information Collection. The first step in planning the technical aspects of a routine inspection is to anticipate the conditions to be expected at the facility so that appropriate inspection activities and resources can be prepared. Relevant sources of information to be compiled for this purpose are as follows.

- Facility Attachment - an agreement between the state and the IAEA that includes facility design and process operation descriptions, permitted safeguards activities, records to be maintained by the facility, and reports to be submitted by the State.

- State Reports - communications from the state to the IAEA reporting on materials balances for each balance area (Materials Balance Report), on movements of material across the boundary of a balance area (Inventory Change Report), and on the current material inventory at the facility (Physical Inventory Listing).

- Computerized Inspection Report - a report completed by the inspector that describes in detail the activities completed during an inspection, including seals attached, detached, or verified; records and reports audited; materials verified by measurement; and the measurement method.

- Routine Inspection Activity List – a description of the safeguards approach at a facility, including a general description of the inspection activities.

2. Determination of Facility Conditions. Facility conditions relevant to inspection planning are the structure of the State's system of accounting, the structure of operating records, the locations and amounts of nuclear materials, changes in operating conditions since the last inspection, and any special conditions such as rebatched fuel assemblies. These conditions are determined from the facility attachment, reports filed by the State, previous inspection reports, and inspector working papers.

This information is the basis for defining inspection activities, such as strategies for auditing records and reports, determining sampling plans, selecting NDA measurement methods, or changes to the safeguards approach indicated by facility operating changes.

3. Determination of Safeguards Conditions. The status of safeguards at the facility consists of the disposition of safeguards equipment, such as film cameras, CCTV, seals, and NDA instruments, and the existence of unresolved anomalies requiring follow-up actions. These factors are determined by reviewing previous inspection reports and inspector working papers.

Knowledge of these conditions allows the inspector to estimate resources for servicing installed containment/surveillance devices, to determine NDA instruments to be shipped, and to define activities for resolving outstanding anomalies.

4. Review of Inspection Activity List. For each facility type, the IAEA has developed a generic set of inspection activities for auditing records and reports, verifying material inventories, and applying containment/surveillance equipment. Before an inspection, these activities should be reviewed to familiarize the inspector with the recommended activities.

5. Specification of Inspection Activities. Generic inspection activities are described in the Routine Inspection Activities Lists; however, within this general outline there is latitude for the inspector to choose the particulars of each activity. Based on the review of facility conditions, safeguards status, and the generic inspection activities, the inspector should determine the intensity and frequency of each activity by specifying its defining parameters. The defining parameters of the generic activities are the following.

- Audit of records and reports
  Examination of accounting/operating records
  Records to be examined; entries to be checked; time period
  Comparison of records and reports
  Records/reports to be compared; entries to be compared; time period
  Update of book inventory
  Material strata; reports records, and supporting documents to be consulted; time period

- Verification of inventory and inventory change
  For each material stratum, specify the verification method—item counting, ID verification, NDA method, and sampling plan

- Containment/Surveillance
  Location of seals to be examined, detached, or attached; location of surveillance units to be serviced, replaced, or installed

6. Determination of Resource Requirements. When information about the current conditions at the facility is completed, and specific inspection activities are identified, the lead inspector can arrange for the resources to carry out these activities. For example, estimates of the number of items in each stratum are used to plan sample sizes for measurements or taking of samples, and the numbers and types of measurement instruments; surveillance unit records determine the number of replacement film cassettes and batteries for cameras; and lists of seals in place at a facility determine the numbers of seals and seal wires to be installed.

This phase of planning should result in requirements for instruments; calibration standards; containment/surveillance equipment including seals, seal wires, cameras, film, and batteries; sampling equipment and containers for sample shipment; and supporting documents such as lists of seals, logsheets from previous inspections, and lists of surveillance equipment and their locations.

7. Schedule of Inspection Activities. The final step in inspection planning is completion of a schedule that coordinates the inspector and equipment resources. The schedule specifies the sequence of inspection activities, the assigned inspectors, and the estimated time for completion.

VI. QUALITY CHARACTERISTICS FOR INSPECTION PLANNING

Quality characteristics of an inspection plan are attributes that are essential to accomplishment of the safeguards goals at the facility. These goals are attained by gathering specific pieces of information through completion of inspection activities that include examination and comparison of records, verification of inventories and inventory changes, and application of containment/surveillance measures. Quality characteristics that measure the degree to which these goals are attained are (1) completeness to assure that all essential information is acquired by at least one inspection activity and (2) continuity to assure that successive inspections at the same facility are coordinated over time

A complete inspection plan should contain inspection activities of sufficient intensity and frequency to verify the current safeguards status of the material at a facility. Thus, a complete plan not only includes audits of records and reports, verification of materials, and application of containment/surveillance measures but also implements these activities with sufficient intensity that IAEA goals for detection material loss are attained. For example, sampling plans for audit of records and reports and for material measurement should be sufficient to detect loss of a significant quantity with adequate probability; where possible, verification methods providing a quantitative estimate of material amount should be applied; surveillance equipment should be deployed for complete coverage of potential routes for undeclared movement of material; and material measurements and verification of seal integrity should be made with sufficient frequency to attain IAEA timeliness goals. In general, a complete plan employs periodic verification methods to arrive at some knowledge position and maintains that position through containment/surveillance measures such as seals or surveillance.

Continuity for inspection planning addresses the quality of coordination between successive inspections. Because safeguards conclusions for a materials balance area are drawn over extended periods of time, evidence for these conclusions is generated from a number of separate inspections at the facility. To avoid gaps or inconsistencies in the information gathered by successive inspections, planning encompasses multiple inspections at the same facility. For example, time periods for examining and comparing records and reports should be contiguous with the time period covered in the last inspection; replacements of particular film, batteries, and seals may depend on which of these items were not replaced at the last inspection. Thus, continuity for inspection planning addresses coordination of inspection activities over time.

II. MONITORING CONFORMANCE TO A STANDARD AND CORRECTING DEFICIENCIES

The final steps in a quality assurance program for inspection planning are to monitor the actual process, compare it to the standard to detect deviations from the standard, and take corrective action. Monitoring is implemented by a management information system that gathers data relevant to the quality characteristics of completeness and continuity and summarizes this information for decision making about the actual process. Such a system is currently a part of routine planning within the Operations Divisions and includes both pre- and post-inspection reviews of the inspection plan and a Computerized Inspection Report that summarizes each inspection plan and its results.

Because these activities are presently not recognized as quality assurance functions, the following describes this review process and interprets it in terms of a quality assurance activity. The form of these review activities is summarized in Fig. 1.

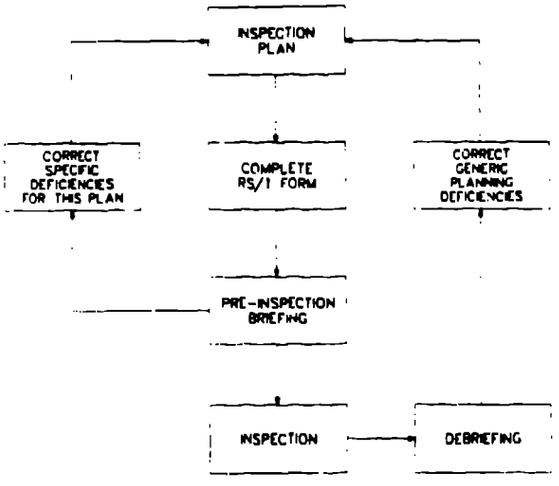

Fig. 1.
Monitoring and correcting planning conformance to a standard.

Pre-Inspection Quality Assurance. Before the implementation of the inspection plan at a facility, there are several key points in the planning process where the conformance of the plan to a standard is confirmed. These points are

(a) Group Leader -- The inspection plan is initiated by the lead inspector in conjunction with his group leader. This provides an early opportunity for an informal management review of the plan.

(b) Pre-inspection Briefing - A more formal review of the inspection plan is conducted with the lead inspector, other participating inspectors, group leader, section head, and, on occasion, a representative from the Plans Section.

(c) RS/1 Form - The plan is finalized in the RS-1 Form, which is a summary of the general inspection activities that are planned. Because this form is part of the Agency Computerized Inspection Report, it is available to other divisions within the IAEA.

(d) Approval by Division Coordinator The inspection plan is approved by the Division Coordinator.

These four steps constitute a verification of the plan's conformance to the standard. Within Operations, the plan is monitored by several management levels including group leaders, section head, and division coordinator, and the dissemination of the computerized RS/1 form broadens the planning review to other divisions. At each stage in this process, there is an opportunity to identify deficiencies and, time permitting, to modify the plan.

Post-Inspection Quality Assurance. Following each inspection, the Operations Divisions have implemented an after-the-fact review of inspection results through a debriefing of the participating inspectors and a formal documentation of these results in the Inspector's Summary Logsheet. Because deficiencies in the implementation of inspection activities may reflect deficiencies in the planning process, the debriefing and formal documentation provide a further means for monitoring planning quality.

Comparisons of the planned inspection procedures with their implementation at the facility that are made in the post-inspection debriefing and computerized reports can identify deficiencies in planning. For example, by comparing the RS/1 Form that represents the planned activities with the Summary Logsheet that represents the actual activities, differences that could be related to planning deficiencies are identified. Typical reasons for not completing an activity may be (1) facility operator or process status did not permit the activity, (2) lack of proper equipment or documents, or (3) insufficient time. Although any of these conditions may be caused by circumstances beyond the inspector's control, they could also be caused by poor planning, such as failure of the inspector to anticipate conditions at the facility or to communicate with the operator, failure to select the correct measurement instruments, or failure to schedule a sufficient number of inspectors. Thus, disparity between the RS/1 Form and the Logsheet may indicate an area where planning should be improved.

REFERENCES

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2. Quality Control Handbook, J. M. Juran, Ed. (McGraw Hill Book Co., New York, 1962).